salts are presented. For combinations of citric acid and sodium chloride it was found that for a wide range of concentrations, mixtures of these substances were more toxic than either alone. In this case the effect seems to be additive. The concentration of hydrogen ions was found to be the chief factor determining the production of giant cells. The production of mucor yeast, which is in no wise related to the production of giant cells, is determined chiefly by the absence of oxygen in slightly acid media containing sugar.—H. HASSELBRING.

Food substances and growth.—The fact that any given result in plant physiology is usually the result of several factors and is only rarely traceable to one factor alone receives further emphasis in the recent work of BOTTOMLY.[17] Mineral nutrients and toxins have received much attention in the discussion of the causes of soil fertility, and both have been shown to be limiting factors in certain cases. BOTTOMLY'S work emphasizes the idea that the soluble humus of the soil is an essential factor in soil fertility, providing not only food and energy for numerous soil bacteria, but also serving as a source of food for plants. His interpretation of the work reported in this paper is that the chief interest in it centers around the possibility that the nutrition of a plant depends, not only upon the supply of mineral food constituents, but also upon a supply of certain accessory organic food substances, very small amounts of which are sufficient to supply the needs of the plant. He cites literature indicating that other workers have found that soil humates stimulate the action of nitrogen-fixing bacteria and also that they can be readily assimilated by plants.

BOTTOMLY finds that when peat is submitted to the action of certain aerobic soil organisms (he does not say what ones) at 26° C., it decomposes rapidly "and a large amount of the humic acid present is converted into soluble ammonium humate." His use of the terms "humic acid" and "humates" is interesting in the light of the recent statement by SCHREINER[18] that "the compounds . . . . such as humic acid . . . . have absolutely no existence, but are shown to be mixtures of many widely different compounds." In this connection it may be noted that WIELER[19] has taken the view that "humic acids" in soils are inorganic acids resulting, for example, from the action of bases on salts; and that BAUMANN and GULLY[20] have shown that in peat soils the acid properties are due to the colloidal matter of the cell covering the hyaline sphagnum cells.

BOTTOMLY found that bacterized peat, after sterilization, was an excellent medium in which to grow nitrogen-fixing bacteria and apply them to the soil.

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[17] BOTTOMLY, W. B., The significance of certain food substances for plant growth. Ann. Botany **26**:531–450. 1914.

[18] SCHREINER, O., The organic constituents of soils. Science N.S. **36**:577–587. 1912.

[19] WIELER, A., Pflanzenwachstum und Kalkmangel im Boden. 8vo. pp. vii+235. *figs. 43*. 1912.

[20] BAUMANN and GULLY, quoted in Science N.S. **40**:492. 1914.

A large increase in the nitrogen content of soils resulted from the addition of active bacterized peat as compared with controls of the same soils with sterile peat. It was found that an aqueous extract of bacterized peat supplied all of the plant food necessary for water cultures of tomato, barley, and buckwheat seedlings. It was also found that bacterized peat contains a substance or substances that stimulate growth and enables the plants to utilize the normal mineral food constituents (NH_3, P_2O_5, and K_2O) more readily. It is supposed that in nature these growth-stimulating substances are supplied by the decayed organic matter of the soil. Experiments under way are reported to indicate that during the early stages of the growth of the embryo these substances are supplied from the seed.

The results of these experiments with bacterized peat coordinate well with agricultural practice as observed by the reviewer in the Puget Sound region of the United States. In this region sphagnum bogs are readily converted into productive gardens by drainage and cultivation. This growth-stimulating substance (or substances) is soluble in water and in alcohol and is precipitated by phosphotungstic acid. Very little has been determined as to the nature or composition of these growth-stimulating substances, but they are said to resemble in certain ways the accessory food bodies concerned in animal nutrition—GEORGE B. RIGG.

Some Ontario forest conditions.—In order to obtain some exact data regarding the extent and conditions of their forests, the Commission of Conservation of Canada has had surveyed among other regions a portion of Ontario east of Georgian Bay and north of Lake Ontario. The area is within the basin of the Trent River and comprises some 1,345,000 acres, slightly rolling in character, with a very thin soil over the recently glaciated granitic rocks of Archaean and Ordovician age. HOWE[21] reports that two-thirds of this area was originally covered with a more or less pure white pine forest, the remainder being chiefly of hard wood type, in which beech and maple predominated. Now the virgin forest is practically gone, although on account of the poor quality of the scanty soil less than 12 per cent of the area has been farmed and little more is tillable.

In discussing present conditions, four types of forest are recognized. (1) The pure coniferous forest with less than 10 per cent of other trees is made up of *Pinus Strobus* with a small quantity of *Tsuga canadensis*. It occupies less than 5 per cent of the woodland and is now hardly known in virgin condition. (2) The pure hard wood forest contains less than 10 per cent of coniferous trees and occupies the deeper soils, covering about 33 per cent of the forested area. It is composed of *Acer saccharum*, *Fagus grandifolia*, *Betula lutea*, *Tilia americana*, and a few other minor species. From the predominance of the two species first named, both as mature trees and as seedlings, it is evident that this

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[21] HOWE, C. D., and WHITE, J. H., Trent watershed survey. Commission of Conservation, Canada. pp. 156. *ills.* 16. *maps* 3. 1913.